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Observations made in the Indian Seas." By the Rev. W. Whewell, B.D., F.R.S., Fellow of Trinity College, Cambridge.

This paper contains the results of the examination by the author of certain series of tide observations made at several places in the Indian Seas, which were forwarded to the Admiralty by the Hon. East India Company. These localities were Cochin, Corringa River, Surat roads in the Gulf of Cambay, Gogah, on the opposite side of the same gulf, and Bassadore, in the Island of Kissmis in the Persian Gulf.

"On the Electrolysis of Secondary Compounds." In a letter addressed to Michael Faraday, Esq., D.C.L., F.R.S., Fullerian Professor of Chemistry in the Royal Institution of Great Britain, &c., &c. By John Frederic Daniell, Esq., F.R.S., Professor of Chemistry in King's College, London.

The discovery of definite electrochemical action naturally suggests the inquiry into the relative proportion of that part of a voltaic current, which, in the case of its decomposing a saline solution, is carried by the elements of the water, and that part which is carried by the elements of the saline compound, and into the definite relations, if any such there be, subsisting between the two electrolytes so decomposed. This question was the origin of the investigation which forms the subject of the present letter. The power which the author employed in this experimental inquiry was that of a small constant battery of thirty cells, six inches in height, with tubes of earthenware, charged in the manner he has described in his former communications to the Society. The result of the first experiment evidently indicated that the decomposition of one equivalent of water was accompanied by the decomposition of an exact equivalent of sulphate of soda. The author then endeavours to ascertain whether the power of the current is equally divided between what had hitherto been regarded as the two equivalent electrolytes. The first experiments he made in order to determine this point seemed to lead to the extraordinary conclusion, that the same current which is just sufficient to separate an equivalent of oxygen from an equivalent of hydrogen in one vessel, will at the same time separate an equivalent of oxygen from one of hydrogen, and also an equivalent of sulphuric acid from one of soda in another vessel.

The author then examines the remarkable phenomena relative to the transfer of matter from one electrode to the other without the decomposition of the transported compound; a phenomenon which was first observed by Mr. Porret in glass cells divided into two compartments by a diaphragm of bladder.

Having observed that the products of electrolyzation cannot be kept long separate in their respective cells, on account of the ultimate mixture of the liquids on the platinode side of the diaphragm, the author was led to construct an apparatus by which this evil is remedied much more perfectly, and to which he gives the name of *the double diaphragm cell*. It consists of two cells, formed of two glass cylinders, with collars at their lower ends, fitted by grinding

to a stout glass tube bent into the form of the letter U, and firmly fixed on a wooden post. The current transmitted by this double cell is more retarded than when passing through the single cell, on account of the greater distance of the electrodes; but it answers its intended purpose of stopping the transfer of the liquid even in the case of saline solutions, and there is still sufficient conducting power to render it powerfully effective. Experiments were then made to ascertain whether in the electrolysis of the dilute sulphuric acid any transfer of the acid takes place; from which the author concludes that during the electrolysis of an equivalent of water, a portion of acid passes over from the platinode to the zincode; and possibly an equal portion of water also passes over from the zincode to the platinode. These experiments appear to confirm the results previously obtained; namely, that one fourth of an equivalent of sulphuric acid passes from the platinode to the zincode for every single equivalent of a compound which has been electrolyzed by the current.

The author then proceeds to examine the following question, viz.: does the acid during its transfer, in the case of the mixed acid and water, or do the acid and the alkali, in the case of the saline solution, convey any portion of the current which effects the simultaneous decomposition of the water in both instances? He next investigates the action of the voltaic current on the aqueous solution of the chlorides, as the simpler constitution of this class of salts promised to throw some light on the nature of the electrolysis of secondary compounds.

The results of all these experiments tend to the establishment of the fundamental principle, that the force which is measured by its definite action at any one point of a circuit cannot perform more than an equivalent proportion of work at any other point of the same circuit; and that the current, which is measured by its electrolysis of an equivalent of simple chloride of lead, cannot at the same time be sufficient to electrolyze an equivalent of chloride of sodium, and an equivalent of water, at the same electrodes. The sum of the forces which held together any number of *ions*, in a compound electrolyte, could, moreover, only have been equal to the force which held together the elements of a simple electrolyte, electrolyzed at the same moment in one circuit.

In applying these principles to the electrolysis of the solution of sulphate of soda, water seems to be electrolyzed, and at the same time the acid and alkali of the salt appear in equivalent proportions with the oxygen and hydrogen, at their respective electrodes. It cannot be admitted, that after the decomposition of the water there is any excess of force applicable to the decomposition of the salt; but it must be concluded that the only electrolyte which yields is the sulphate of soda, the *ions* of which, however, are not the acid and alkali of the salt, but an *anion*, composed of an equivalent of sulphur, and four equivalents of oxygen and the metallic *cation*, sodium. From the former, sulphuric acid is formed, at the *anode*, by secondary action, and the evolution of one equivalent of oxygen; and from the latter, soda at the cathode, by the secondary action of

the metal, and the evolution of an equivalent of hydrogen. The formation of these secondary electrolytes, and compound anions and cations, will probably furnish the key to the explanation of many of those decompositions and recompositions, to which the presence of water is necessary, such as those of nitric acid on the metals, and the formation of Schönbein's circuit: but the author reserves for a future opportunity the examination of this hypothesis, as well as of the general question.

“Experimental Researches on the mode of operation of Poisons.”

By James Blake, Esq. Communicated by P. M. Roget, M.D., Sec. R.S.

In this paper the author examines more particularly the action of those poisons which appear to produce death by affecting the nervous system.

After reviewing the evidence adduced in support of the opinion, that the effects of some poisons are owing to an impression made on the nerves of the part to which they are directly applied, he proceeds to relate a series of experiments undertaken in order to show with what rapidity the blood is circulated through the body, and tending to prove, that a substance may be generally diffused through the system in nine seconds after its introduction into the veins.

Experiments are then related in which the more rapidly fatal poisons had been used, and in which it was found, that an interval of more than nine seconds always elapsed, between the administration of a poison, and the appearance of the first symptoms of its action. The mere contact of a poison with a large surface of the body appears to be insufficient to give rise to general effects, as long as it is prevented from entering into the general circulation.

Various causes of fallacy in experiments of a similar kind, which have been adduced in support of an opposite opinion, are pointed out. The following is a summary of the conclusions arrived at by the author.

1. The time required for a substance to penetrate the capillary vessels, may be considered as inappreciable.
  2. The interval elapsing between the absorption of a substance by the capillaries, and its general diffusion through the body, may not exceed nine seconds.
  3. An interval of more than nine seconds always elapses between the introduction of a poison, into the capillaries, or veins, and the appearance of its first effects.
  4. If a poison be introduced into a part of the vascular system nearer the nervous centres, its effects are produced more rapidly.
  5. The contact of a poison with a large surface of the body is not sufficient to give rise to general symptoms, as long as its diffusion through the body is prevented.
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